DESCRIPTION

MOBATIME Network Clocks

Setup, configuration and operation

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1 Introduction

This document describes the functions of the MOBATIME network clocks. There are additional functions available, depending on the individual type of clock. The operating manuals provide specific information concerning individual clock types.

This document refers to the clock types of the 2nd generation: SAN / SEN 40, NBU 190, TREND NTP, NMI, NCC, DC3, ECO-DC, DK, DA.

Not included in this group are SEN 00, NCI, WTD 868.

This manual is valid starting with software version V2.00 (versions with integrated IPv6).
For older versions (devices that only support IPv4), the manual BE 800793.06 must be used.

1.1 Terms

MOBA-NMS	MOBATIME Network Management System: Tool to configure the network devices of MOBATIME
Slave clock	analogue clock movement, digital clock
Clock	slave clock
NTP	Network Time Protocol – time distribution via network
DTS	Distributed Time System: Master clock system by MOBATIME
Master clock	master clock frequently includes a radio time receiver (DCF, GPS,...)
Time server	master clock with an NTP server
NTP server	master clock that provides time via NTP
PoE	Power over Ethernet, power over the network

2 Methods for configuration

There are four different configuration methods:

- DIP switch, button and remote control of the device
- MOBA-NMS
- DHCP
- SNMP V2c

These methods can be used individually (e.g. configuration via DIP switches in multicast mode) but also combined (e.g. network parameters via DHCP and NTP server configurations by MOBA-NMS).

Important: In many cases, configuration changes will lead to a restart of the clock.

2.1 DIP Switches, Button, Remote Control or Menu via Telnet

The initial configuration may be carried out by various means, depending on the type of clock.

2.2 MOBA-NMS configuration software

Operating software to configure and operate MOBA Time network devices. Java-based (independent of operating system → Windows, Linux), modular, expandable with plug-ins.

Compared to a browser-based solution, the benefit is primarily the ability to administrate several devices simultaneously (grouping).

Functions:

- Operation and configuration
- Search of MOBATIME devices
- Grouping of devices
- Monitoring of devices, logging alarms
- Firmware update of devices
- User administration
- Additional functions: Port sniffers for NTP and time zone packets, edit time zone entries, local user administration and update mechanism.

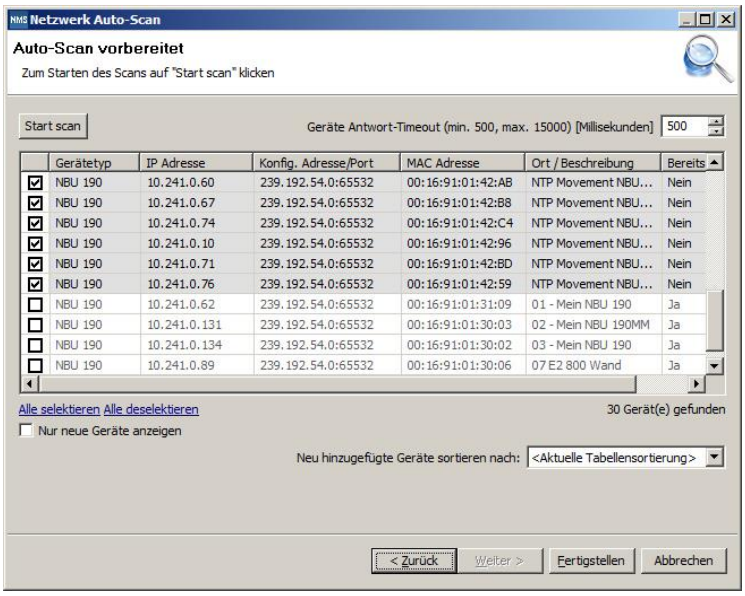
The software communicates via multicast or unicast mode (depending on what is available) through the configured UDP port.

MOBA-NMS primarily communicates via multicast and switches to unicast mode as soon as it is determined that the device has an IP address.

Devices that have been configured to unicast, which did not receive an IP address per DHCP, can have the IP address set manually over multicast.

2.2.1 Automatic device scan

MOBA-NMS is able to search the network automatically for MOBATIME network devices. This is a very helpful function especially for managing many devices and it allows compiling all devices into a list form within seconds. During the scanning process, one can restrict the search to certain types of devices (e.g. only for NBU 190 clock movements) and one can sort the result by various criteria.



Automatic network scans are carried out over either multicast or unicast (IP range scan). In addition, devices can be retrieved manually with known IP or MAC addresses.

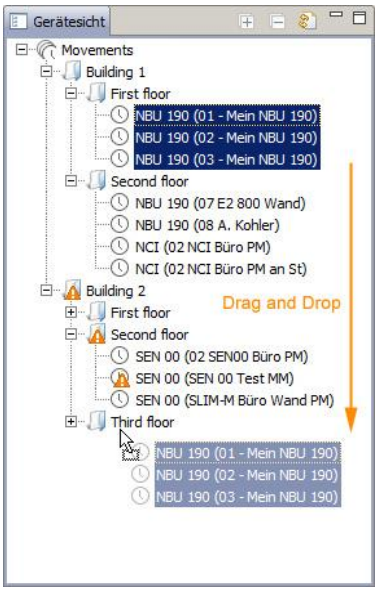
2.2.2 Device management

All network devices located (by automatic scan or manually configured) are shown in the so-called device view. It allows summarizing these by device groups according to various criteria. Individual devices are simply moved into the appropriate groups using drag and drop and sorted among one an-other. The number of groups and subgroups is not restricted.

In addition to organizational benefits (easy retrieval, better overview), a device group has also the following benefits:

- Commands or device updates can be applied to the entire group (including subgroups).
- Alarms or errors of included devices are shown at the group level.
- Entire groups can be moved / sorted among one another.

The content of the device view can be saved and reopened later. Therefore, the created structure and breakdown within the groups is retained.



2.2.3 Status / alarm notification

The device view shows device alarms or errors directly in the overview with an appropriate icon. These can be updated over entire groups to receive the current status of the devices.

2.2.4 Support / analysis

Furthermore, MOBA-NMS offers some useful tools for analyzing network traffic. This is specifically helpful for error analyses and facilitates finding of a solution. The NTP monitor records all NTP packets, which were sent on one or several multicast groups. The time zone monitor records analogous all packets containing time zone information.

2.3 SNMP

SNMP version: V2c
SNMP is turned on by default.

UDP Port 161 for SNMP access with **GET/SET**
Notifications are sent to the UDP Port 162.

The following MIB definitions are used:

- MIB II: Partial support of MIB II (RFC 1213) with at least (device-dependent):
  - sysDescr
  - sysObjectID
  - sysUpTime
  - sysContact
  - sysName is an alias of the device description from Moba NMS
  - sysLocation
  - sysServices
- Private MIB: MOBANetClock.MIB with device specific parameters

Communities:

Reading:	romobatime
Write/read:	rwmobatime
Notifications (traps):	trapmobatime

GET BULK command is not available!

2.3.1 Notifications

See chapter 5.1 SNMP V2c Notification

2.3.2 Device Configuration with SNMP (SNMP Agent)

If one or several variable(s) are replaced by **SET** in one configuration group then at the end, the variable *mbnsc????ConfigCmd* must be set to 1 in the appropriate group. The clock accepts the values of the entire configuration group with this command (1=accept). Both steps may be set in one SNMP **SET**.

As long as the Accept command is not set, the changed variables can be reset to the previous values by setting the variable *????ConfigCmd* to 2 (2=undo, restore).

The definitions of the available variables are specified in the MOBANetClock.MIB.

Example:

Management system		**clock**
SET mbnscNetSnmpMode = 1	→	Variable will be internally assigned to 1
SET mbnscNetConfigCmd = 1	→	configuration group will be accepted

At the end of the MIB file, a conformance/compliance table lists the available parameters for the respective device, e.g. „mbnscGrpNBU190“ for NBU 190.

2.4 DHCP

In the unicast operating mode, the clock tries to retrieve the network configuration from a DHCP server in the network. The following DHCP options (RFC 2132) are checked automatically:

[50] IP address
[3] Gateway address
[1] Subnet mask
[6] DNS server
[42] List with up to four NTP server addresses
[42] Time zone server address (usually the same as the NTP server address)
[43] Additional options (as an alternative to [224])
[224] Additional options:

Format: MOBA<TypeID>:<Data>
MOBA identification string MOBA*TIME* devices
TypeID clock type:

0004	NBU 190
0005	ECO-DC
0006	DC3
0007	SEN 40
0008	SAN 40
0009	DA
0010	DK2
0011	NMI
0012	TREND
0013	TREND double-sided
0014	DSC
0015	DSC100
0017	NCC
0019	ECO-M-DC
0020	TZ

Data identifier_1=value_1;identifier_2=value_2…

Identifiers for Data:

ntp1, ntp2, ntp3, ntp4	NTP server as an alternative to [42], has priority compared to [42]
ntppoll	poll interval NTP requests
snmp1, snmp2	SNMP receiver for notifications
alive_to	SNMP Alive Notification Interval
snmp_mode	SNMP Agent Mode
tz_nbr	Time zone number (e.g. 2 = Brussels)

Example:
MOBA0004:alive_to=30;snmp1=192.168.23.45

See chapter 7 for details.
Maximum length of the configuration string: 200 characters

Important: It is the responsibility of the network administrator to configure the DHCP options appropriately.

Important: DHCP parameters have higher priority than the manual settings on the device.

DHCP request

In the DHCP request, an identification string is sent to allow sending parameters selectively to devices on the DHCP server:

[60] Vendor Class Identifier: MOBA with attached Type ID (e.g. MOBA0004 for NBU 190)

In addition, the configured host name is sent (dynamic DHCP)

[12] Host name

DHCP static:
The DHCP assigns an IP address which was previously assigned to a MAC address (configuration (configuration DHCP server).

DHCP dynamic:
DHCP assigns an IP address from the address pool.

2.5 DHCPv6

In the unicast operating mode (IPv6), the clock tries to retrieve the network configuration from a DHCPv6 server in the network. The following DHCPv6 options (RFC 3315) are requested and checked automatically:

[3] IP address:

[17] Vendor options:

Format: <Enterprise ID>:<Option Code>:<Length Data>:
MOBA<TypeID>:<Data>

Enterprise ID	Moser-Baer AG = 13842
Option code	0x0001
Length data	Length from (including) MOBA
MOBA	Identification string MOBA*TIME* devices
TypeID	see option 224 in chap. 2.4 DHCP
Data	identifier_1=value_1;identifier_2=value_2…

Identifiers for data:

ntp1, ntp2, ntp3, ntp4	NTP server as an alternative to [31], has priority compared to [31]
ntppoll	poll interval NTP requests
snmp1, snmp2	SNMP receiver for notifications
alive_to	SNMP Alive Notification Interval
snmp_mode	SNMP Agent Mode
tz_nbr	Time zone number (e.g. 2 = Brussels)

Example:
<134482><1><Length>MOBA0004:alive_to=30;snmp1=192.168.23.45

[23] DNS server

[24] Domain

[31] List with up to four NTP server addresses

See chapter 7 for details. IP addresses must be IPv6! DHCPv6 can be deactivated on the clock.

Maximum length of the configuration string: 200 characters

Important: It is the responsibility of the network administrator to configure the DHCP options appropriately.

Important: DHCPv6 parameters have priority compared to manual settings on the device and compared to DHCP (v4).

DHCPv6 request

To selectively send out parameters to devices on the DHCPv6 server, an identification string is sent in the DHCPv6 request:

[16] Vendor Class Option: Enterprise ID and identification string with clock type are sent with the request (see option 224 in chap. 2.4 DHCP).

Additionally, the configured host name is sent (dynamic DHCP resp. dynamic DNS/DDNS)

[39] Host name (FQDN)

DHCPv6 static:
DHCPv6 gives out an IP address previously assigned to a DUID (configuration DHCPv6 server). DUID = 00030001001691123456 whereat the last 12 digits correspond to the clock's MAC address.

DHCPv6 dynamic:
DHCPv6 gives out an IP address from an address pool

3 Communication

Generally, all communication goes through Ethernet UDP IP v4 or IPv6. The two IP variants can be used parallel (dual stack) or exclusively (configuration option). In parallel operation, IPv6 has priority compared to IPv4.

3.1 IPv6

IPv6 allows for up to 4 parallel IP addresses, prioritized in decreasing order:
- Address given by DHCPv6
- Fix address
- Address calculated by Auto-Config (SLAAC / RA)
- Link Local address

DHCPv6 and/or autoconfig. can be deactivated.

Calculation of the link local address from the MAC address:
fe80::2[2nd part MAC]:[3rd part MAC]ff:fe[4th part MAC]:[5th part MAC][6th part MAC]

Example: MAC: 00:16:91:12:34:56

IPV6: fe80::216:91ff:fe12:3456

3.2 Addressing types over the network

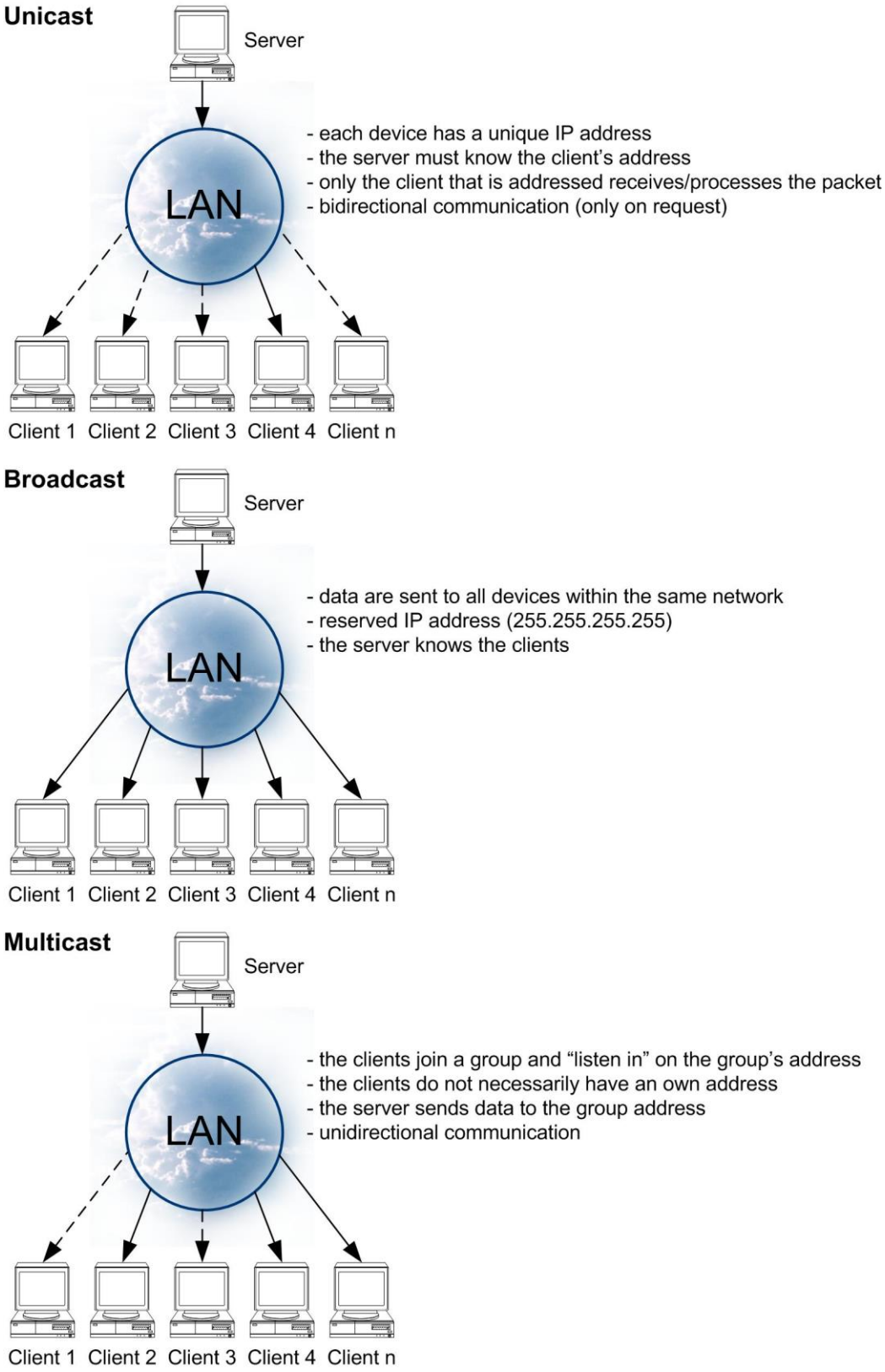


Illustration 1: Network addressing

3.3 Multicast

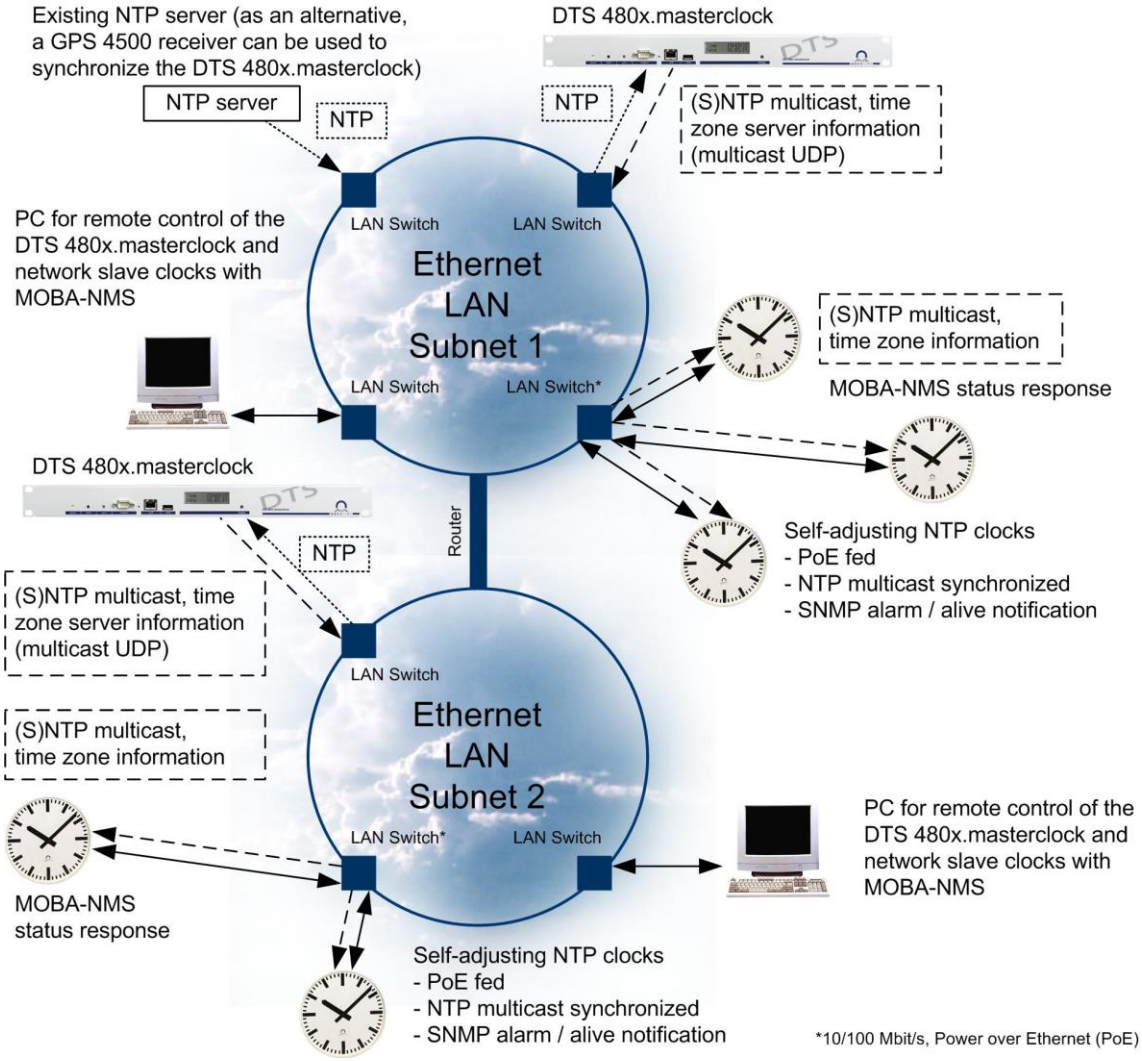


Illustration 2: Multicast setup

3.3.1 Configuration

Multicast is the recommended communication mode: The clock can be configured completely with DIP switches, buttons, or remote (partially also Telnet).

The group address is configured on the clocks (last byte, select from 1 - 15).

Furthermore, this operating mode supports monitoring of the clock via network connection. In addition, configuration parameters can be changed via network connection with the MOBA-NMS software.

In comparison with the unicast mode, the clock receives multicast-addressed NTP and time zone packets from an NTP server to a fixed group address (multicast IP). The multicast operating mode means little configuration efforts for a network administrator (the group address is set directly on the clock).

3.3.2 Synchronization

For synchronization, the clock needs NTP packets from an NTP server in the network (in the Illustration 2: Multicast setup DTS 480x.masterclock in the same subnet). The multicast-addressed packets are sent by the NTP server periodically. The sending interval and the group address must be set on the NTP server.

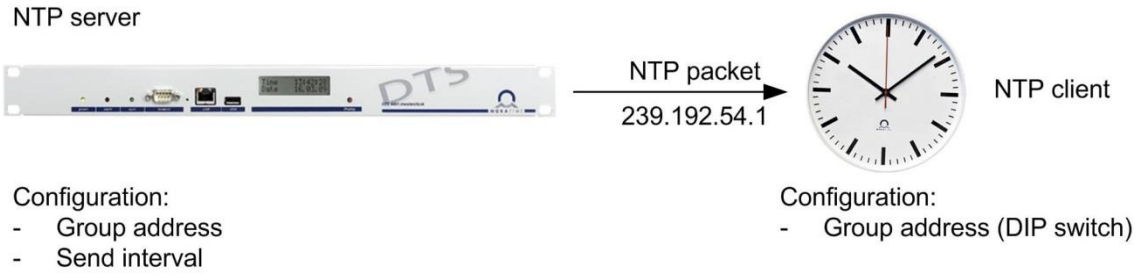


Illustration 3: NTP in multicast mode

E.g., every minute the server sends NTP packets to the multicast group 239.192.54.1. All clocks configured for multicast address receive these packets and take over the time.

Multicast setup (see illustration 2):

A DTS 480x.masterclock (dashed lines) is in every subnet. If the router can transfer the multicast packets (the router must be configured accordingly), all clocks in both subnets can be synchronized by one master clock. Otherwise, one master clock per subnet is needed (the different dash lengths indicate the different synchronization sources).

Both DTS 480x.masterclocks are synchronized by an additional NTP server. Both the external NTP server and the two DTS 480x.masterclocks have one IP address and communicate with unicast packets (dotted lines). Therefore, the router is not a hindrance. As an alternative, the DTS 480x.masterclock can be synchronized with one GPS 4500 receiver.

Time zone information

By definition, the NTP only transmits UTC time. For this reason, the clock needs additional information to show local time. This information can be read from an internal table or from a MOBATIME timeserver. → 4.4 Local Time Calculation / Time zones

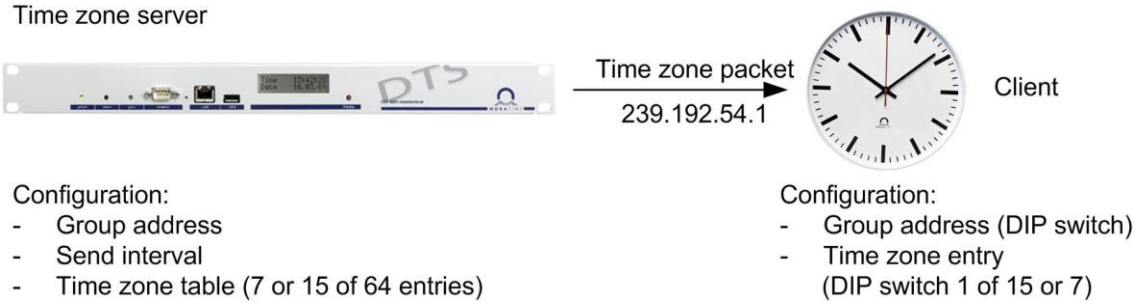


Illustration 4: Time zone information in multicast mode

Concerning the time zone server, the communication works analogous to the above description in reference to the NTP.

3.3.3 Protocol Details

The group address is an IP address from the multicast range 224.0.0.0 to 239.255.255.255. Selected addresses by Moser-Baer AG from freely available ranges:
- IPv4: 239.192.54.x and 239.251.34.x, where x = 1..15

With IPv6, the ranges mentioned above are implemented as follows:
- IPv6: FF3y::EFC0:360x and FF3y::EFFB:220x, where x = 0x1..0xF and y=scope
  e.g.: 239.192.54.5 → FF38::EFC0:3605
  239.251.34.10 → FF38::EFFB:220A
  For scope, the following values are possible:
  ~~2 = Link Local Scope~~
  ~~5 = Site Local Scope~~
  8 = Organization Local Scope
  ~~14 = Global Scope~~

NTP packets correspond to the standards RFC 1305 (V3) and RFC 4330 (SNTP V4). The NTP communicates via UDP Port 123. NTP server can send NTP packets in both unicast, broadcast, and multicast.

Time zone packets contain proprietary information. UDP is used by default port 65534. Time zone server can send NTP packets in both unicast, broadcast, and multicast

MOBA-NMS communication contains proprietary information. UDP is used by default port 65532. The MOBA-NMS communicates with the clock in multicast mode. One of the group addresses (multicast IP) 239.192.54.0 or 239.251.34.0 resp. IPv6 FF38::EFC0:3600 or FF38::EFFB:2200 is used. The clock responds to the MOBA-NMS in unicast mode with the ancillary address 1.255.255.253 or 0.0.0.0 resp. one of the possible IPv6 addresses (link local, autoconfig, fix, DHCPv6) as sender.

In multicast, the clock sends an IGMP (V2) packet every 3 minutes to request the router to forward the multicast packets (making the group allocation known).

3.4 Unicast

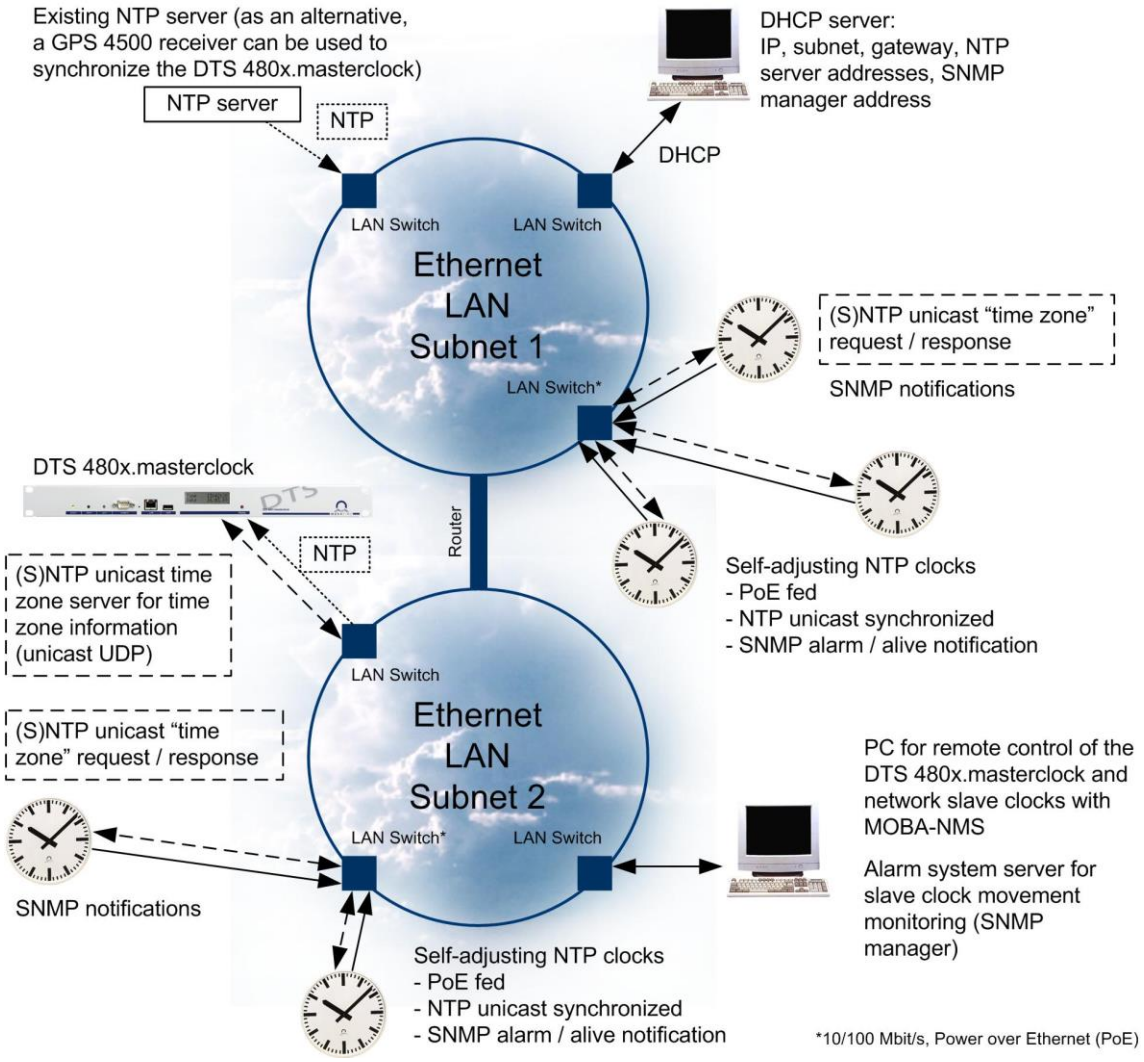


Illustration 5: Unicast setup

3.4.1 Configuration

The unicast mode is configured on the clock by DIP switches, buttons, or remote control. The configuration may be carried out automatically by a DHCP server or manually with the MOBA-NMS software.

IPv4

Static network parameters:
DHCP can be turned off via MOBA-NMS and the complete network configuration can be set statically in the clock. Manual assignment of the IP address (and other parameters) by the network administrator using MOBA-NMS or SNMP V2c (in any case, the address is static).

Automatic assignment of the IP address by a DHCP server within the same net (in any case, the address is dynamic). In this operating mode, the clock will attempt to retrieve the following network parameter from a DHCP server (see also chapter 2.4 DHCP):

IP address
Gateway address
Subnet mask
NTP server address(es) / time zone server address

NTP request interval
SNMP manager address
SNMP alive notification interval

The network administrator must configure the NTP server addresses as DHCP option on the server. As an alternative, all parameters with the exception of network configurations can be configured manually via MOBA-NMS or SNMP on the clock provided they are not transmitted by DHCP (DHCP has priority compared to manual settings)

IPv6

Static network parameters:
Manual assignment of a fixed IP address (and other parameters) by the network administrator via MOBA-NMS or SNMP V2c (the address is static in any case).

Automatic assignment of an IP address through autoconfig. (SLAAC / RA) and / or a DHCPv6 server within the same network (the address is generally dynamic).

In the case of DHCPv6, the clock will try to get the following network parameters from a DHCPv6 server (see also chapter 2.5 DHCPv6):

IP address
NTP server address(es) / time zone server address
NTP request interval
SNMP manager address
SNMP alive notification interval

Die NTP server addresses must be configured as DHCP option on the DHCPv6 server by the network administrator. Alternatively, all parameters besides the network settings can also be configured manually on the clock using MOBA-NMS or SNMP as long as they are not sent via DHCPv6 (DHCPv6 has priority compared to manual settings and parameters sent via DHCP (v4)).

3.4.2 Synchronization

If a NTP address is transmitted or set on the clock, it will request NTP and time zone packets (if so configured) from it. The request interval can be configured with the MOBA-NMS software or the DHCP option.

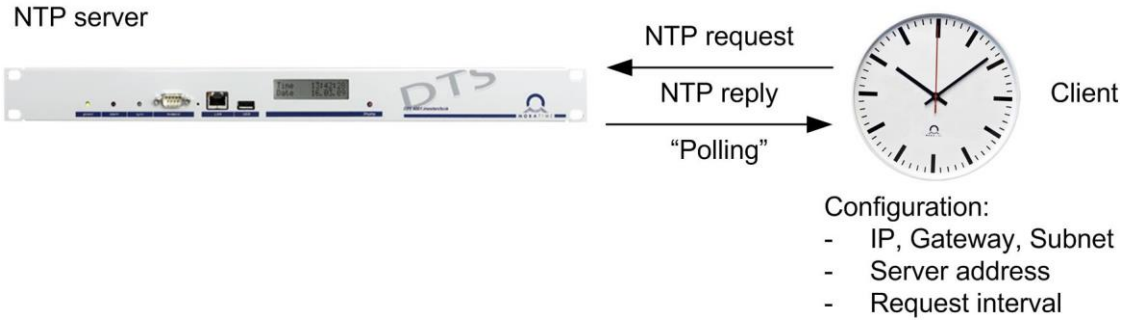


Illustration 6: NTP in unicast mode

Time zone information

Analogue synchronization. See also 4.4 Local Time Calculation / Time zones.

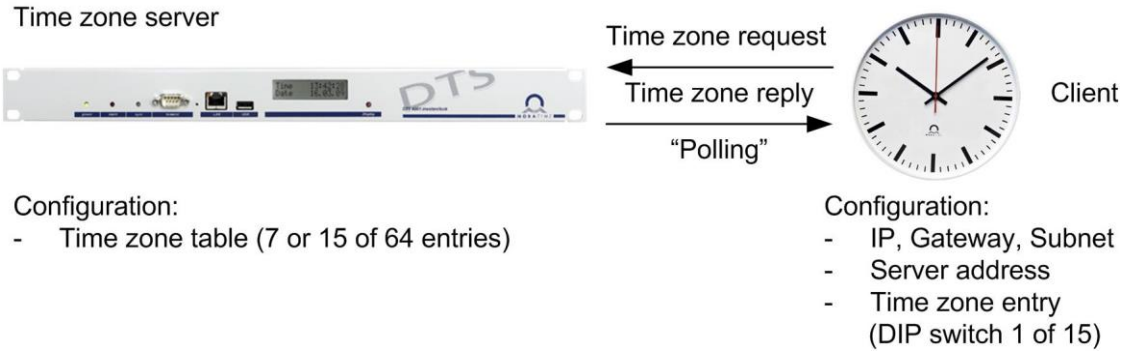


Illustration 7: Time zone information in unicast mode

3.4.3 Protocol Details

If MOBA-NMS is used to monitor and configure, then one of the group addresses (multicast IP) 239.192.54.0 or 239.251.34.0 or the precise IP address over unicast is used (in general, as soon as the IP was recognized).

Time zone packets contain proprietary information. UDP is used by default port 65534. Time zone server can send NTP packets in unicast, broadcast and multicast mode.

MOBA-NMS communication contains proprietary information. UDP is used by default port 65532. The MOBA-NMS communication to the clock is initially established with the multicast mode (one of the group addresses (multicast IP) 239.192.54.0 or 239.251.34.0 is used), and in unicast as soon as the IP is recognized. The clock's response to the MOBA-NMS request contains the current IP address as sender.

Individual requests of NTP and time zone information and the corresponding responses of the servers increase the network traffic by a multitude of every clock (in particular, if many clocks are installed).

The advantage is that the unicast communication can communicate over several networks. Routers must not be configured for multicast.

This type of operating mode supports monitoring and configuring the clock via network connection.

3.5 Comparison of Multicast – Unicast

Multicast	Unicast
The master clock sends to a configured group address periodically time and optionally time zone information. All slave clocks configured to the same group address receive the information and display the appropriate time.	Every slave clock requests periodically time and optionally time zone information from the master clock.
IP addresses must not be administrated / assigned.	Every slave clock has its own IP address, which must be assigned by a DHCP server or a network administrator.
No additional configuration is necessary. The slave clocks can be identified by their unique MAC address (printed on MAC label).	The slave clocks can be identified by their unique IP address or the unique MAC address (printed on MAC label). ICMP ping to the IP address is possible.
There is practically no network load (one single packet reaches the entire group). Unidirectional communication	Significantly higher network load due to information "polling" bi-directional communication
Network delays influence accuracy of slave clocks (transition WLAN / LAN: 100 ms are possible)	Running times can be compensated (symmetrically). This way, network delays do not affect accuracy.
Multicast-addressed packets can be transmitted (IGMP) by network perimeters (routers). One master clock per subnet is probably necessary if no multicast support materialized through the router. Warning: Firewall! (Packets can be blocked)	Unicast-addressed packets are transmitted by network perimeter (router). Warning: Firewall! (Packets can be blocked)
MOBA-NMS supports configuration and monitoring.	MOBA-NMS supports configuration and monitoring.
There is no SNMP function available, if operated solely in multicast.	Can be integrated into a network management system: SNMP V2c

Illustration 8: Comparison Multicast - Unicast

Unicast and multicast can be combined.

3.6 Overview of available communication

Function	Multicast	Unicast			
		Static IP (v4/v6)	DHCP (v4/v6) static	DHCP (v4/v6) dynamic	SLAAC (IPv6 only)
MOBA-NMS	X	X	X	X	X
SNMP		X	X	X	X
SNMP Notification (Traps)		X	X	X	X
NTP	X*	X	X	X	X
Time zone server	X	X	X	X	X

* no runtime compensation

3.7 Device communication using MOBA-NMS

Depending on device type, MOBA-NMS is capable of building up the communication in different ways. The unicast communication is preferred; however, depending on settings, a pure multicast communication can be used. Furthermore, host names can be assigned to IP addresses.

3.7.1 Communication mode

The communication mode is defined in the user settings *(Window -> User Preferences…)*. Three options are available:

- **Multicast and unicast (standard setting / recommended):** Multicast is used for the first dial-up. As soon as the IP address of the device is known, the device switches to unicast (if it is supported by the device). For each subsequent connection, this IP address (unicast) will be used. If, at a later time, it is not possible to connect to the IP address, an automatic switch to multicast takes place.

- **Multicast only:** Only multicast is used. Thus, no automatic switch to unicast takes place after the first dial-up.

- **Unicast only:** The device will always try to communicate directly over unicast. The automatic switch to multicast in case of an error is deactivated.

Important: If the automatic switch to multicast in case of an invalid IP address (wrong subnet) does not work, change the NMS setting to **Multicast only**. Over multicast the IP address can be changed.

3.7.2 Host name / FQDN (DNS)

MOBA-NMS is also capable of assigning IP addresses to the host name or FQDN (Fully Qualified Domain Name). Here, the device checks if the host name is known and can be assigned to an IP address. If this is the case, the defined address is used for communication. The host name assignment needs to be explicitly activated in MOBA-NMS. *(Window -> User Preferences… -> Network -> activate „Resolve host names (DNS) to get device IP addresses“.)*

Note for slave clocks:
Slave clocks themselves save only the host name, but not the domain name. Thus, the standard domain name can be defined in the settings. It is used in all devices without saved domain to form the FQDN.

Example:

Slave clock host name:	*netclock*
Standard domain:	*mobatime.com*
Automatically formed FQDN:	*netclock.mobatime.com*

Tip:
The standard domain can also be defined per device group (select group and click *Edit -> Group settings…*). This way, devices from different domains can be managed parallel in MOBA-NMS.

Attention: Assigning host names requires the network to contain an appropriate DNS server and all devices need correct host names! On the DNS server, the host names must either be saved statically or set via dynamic DNS (DDNS) from the DHCP (v4 or v6) server.

3.7.3 Overview dial-up

Whether communication takes place over IPv4 or IPv6 is either defined during the device search or is configured later in the connection settings of the respective device. With IPv6, the various IP addresses are prioritized according to chapter 3.1 IPv6.
The table below shows for each communication mode the order of actions MOBA-NMS uses to try and establish a device connection.

	Multicast and unicast	**Multicast only**	**Unicast only**
1.	*Host name known and assigning (DNS) activated:* Assign host name.	-	*Host name known and assigning (DNS) activated:* Assign host name.
2.	*IP address known:* Dial-up unicast. *IP address not known:* Dial-up multicast.	Dial-up multicast	Dial-up unicast
3.	*Unicast connection failed:* switch to multicast	-	-
4.	Dial-up multicast	-	-
5.	*IP address known:* Switch to unicast (for next dial-up)	-	-
End			

4 Time Distribution

4.1 NTP

The time is distributed via NTP (Network Time Protocol).
NTP variants:

- SNTP: Runtime alignment but no time stats
- Multicast SNTP: Neither runtime alignment, nor time stats

Unicast or multicast communication using UDP Port 123.
Definition in accordance with RFC 1305 and RFC 4330.

NTP includes UTC (coordinated universal time)

4.2 Precision / Synchronization Failure

The deviation in the synchronized condition is typically less than +/- 50 ms.

After an hour, the clock signals a failure of synchronization with an error message "synchronization alarm" per notification or MOBA-NMS and after 24 hours by setting the hands to 12:00 in analogue clocks or blinking of ":" in digital clocks.

If several NTP servers are configured (unicast operations) then a changeover to the next NTP server happens after three NTP requests without response.

After 24 h without synchronization, the deviation is typically less than +/-2 s (quartz preciseness: 20 ppm at room temperature).

Note: The deviations stated depend on the preciseness and performance of the time source (NTP server). The NTP reception can be influenced by network load and network devices (hub, switch, router, firewall, etc.).

4.3 Redundant Time Source

The availability of NTP servers as time source can be improved by redundant versions. Depending on the operating type of the clocks, the following strategy is recommended (the same applies to time zone servers):

4.3.1 NTP Client Unicast

As DHCP option or by manual configuration (MOBA-NMS), the clock can have up to **four different NTP server addresses**. If the current server does not respond to three time requests in sequence then the clock switches to the next server (if available). The time to the switchover is determined by the configured request interval (default: 3 x 10 seconds). After a restart, the clock starts sending requests to the first server.
Every hour, the clock checks the availability of the primary server; if it is available, the clock switches back.

4.3.2 NTP Client Multicast

Two servers must be installed that send the NTP packets on the same group address (multicast IP). The send intervals of both servers must be chosen in a manner that the primary server synchronizes during standard operations. The secondary server shall synchronize only if the primary server fails. The ratio of the numbers of packets sent by the primary and secondary server should be set at an approximate ratio of 4:1.

- Sending interval primary server: 1 packet / 1 minute
- Sending interval secondary server: 1 packet / 4 minutes

The primary server selects the server that sends most NTP packets per unit of time. If the primary server fails, the secondary server consequently dominates.

4.4 Local Time Calculation / Time zones

NTP clocks are synchronized to UTC (coordinated universal time). In order to calculate and display the local time, the clocks require additional information in form of a time zone entry.

In general, the time zone entry includes rules for changing to daylight savings time / standard time and local time offsets.

4.4.1 Internal table

The clocks have at least 7 but partially up to 64 internal time zone entries. At least 1 and up to 7 entries can be changed with MOBA-NMS.

The current complete time zone table is in the annex (the first 7 positions of the table apply to clocks that only have 7 entries).

4.4.2 Time zone server

As an alternative, the clocks support calculating local time based on the time zone entry of a time zone server. If the clocks operate in unicast mode, they request the entry from the configured NTP server. If the clocks operate in multicast mode, they receive these entries from the configured multicast address. 15 entries can be configured on the time zone server.

The desired entry can be selected on the clock (partially, only from the first 7 of the 15 entries).

Benefit of the time zone server: Only one entity to change / update entries

5 Monitoring

5.1 SNMP V2c Notification

The SNMP manager has 2 addresses available.

Important: For the notifications to be sent, the SNMP must be turned on (default). In addition, at least one receiver system must be configured.

The following traps are sent (only in unicast mode):

5.1.1 coldStart (RFC 1215)

Sent out at every reboot.

5.1.2 authenticationFailure (RFC 1215)

Sent out at each request with a wrong community.

5.1.3 Alive Notification (MOBANetClock.MIB) [mbnscTrapsAlive]

Defined in MOBANetClock.MIB (clocks resp. firmware that only support IPv4) and MOBANetClockV2.MIB (clocks resp. firmware that support both IPv4 and IPv6).

Is sent in a configurable interval (1...1440 min).

This notification is always sent as soon as the SNMP, a receiver address, and an interval > 0 is configured.

The notification sent includes the following data:

Field	Type	Size	Description	Example
mbnscGeneralStatus	Byte array	8 bytes	Includes the internal system status	66309
mbnscGeneralAlarms	Byte array	8 bytes	64 bit alarm flags 1.byte bit 0..7 2.byte bit 8..15 :: 8.byte bit 56..63	FFF870FF.FFFFFFFF ¦ ¦ ¦ 5.byte ¦ ¦ 2.byte ¦ 1.byte

5.1.4 Alarm Notification (MOBANetClock.MIB) [mbnscTrapsAlarm]

Defined in MOBANetClock.MIB (clocks resp. firmware that only support IPv4) and MOBANetClockV2.MIB (clocks resp. firmware that support both IPv4 and IPv6).

If the alarm condition changes, the alarm notification is sent, i.e. when an alarm flag is set or deleted a notification is sent.

This notification is sent as soon as an SNMP and a receiver address are configured.

The notification sent includes the following data:

Field	Type	Size	Description	Example
mbnscTrapAlMsgErrorNr	Byte	1 byte	No of alarm bit (0..63)	8
mbnscTrapAlMsgErrorState	Byte	1 byte	0 = Alarmbit was deleted 1 = Alarmbit was replaced	1
mbnscTrapAlMsgErrorTime	Unsigned Int	4 bytes	PC time in seconds since 01/01/1970 00:00:00	946684805

5.2 SNMP V2c Requests

The clock's condition can be checked periodically depending on the management system.
(Unicast mode only)

5.3 MOBA-NMS

MOBA-NMS allows checking the current condition of the clock at any time.
(Unicast and multicast mode)

MOBA-NMS offers a monitoring mode during which the clocks are periodically checked and any errors are logged.

5.4 Ping

A simple ping can at least check one network connection.
(Unicast mode only)

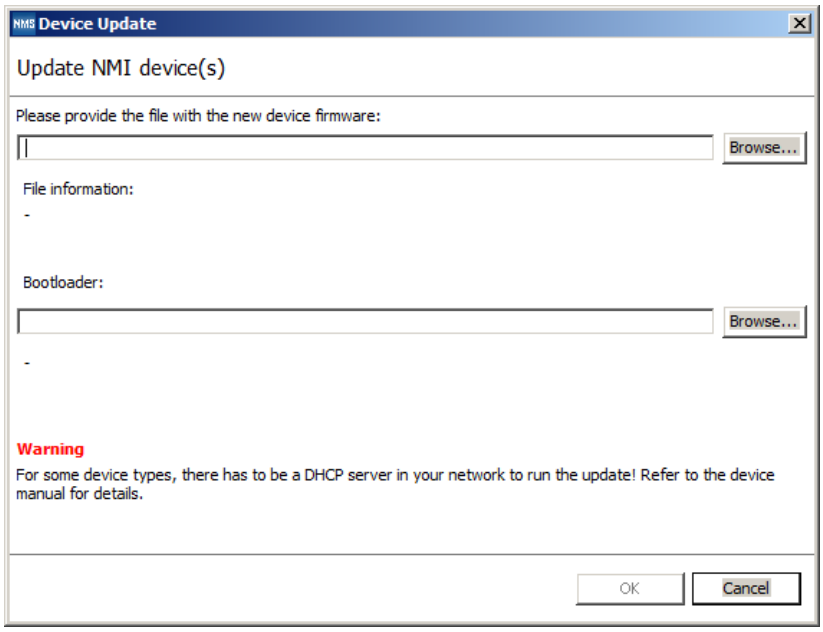
6 Firmware-Update

The firmware of a clock can be updated with MOBA-NMS. However, the settings are lost on the clock depending on the reason for change. TFTP UDP Port 69 is used as protocol. **A DHCP server in the network is mandatory for the update.**

The multicast mode updates several clocks sequentially. In the unicast mode, this is done parallel.

Attention: For the update, a DHCP server in the network is necessary.

Open the Update Window with right mouse click on the device ➔ Commands ➔ Firmware Update:



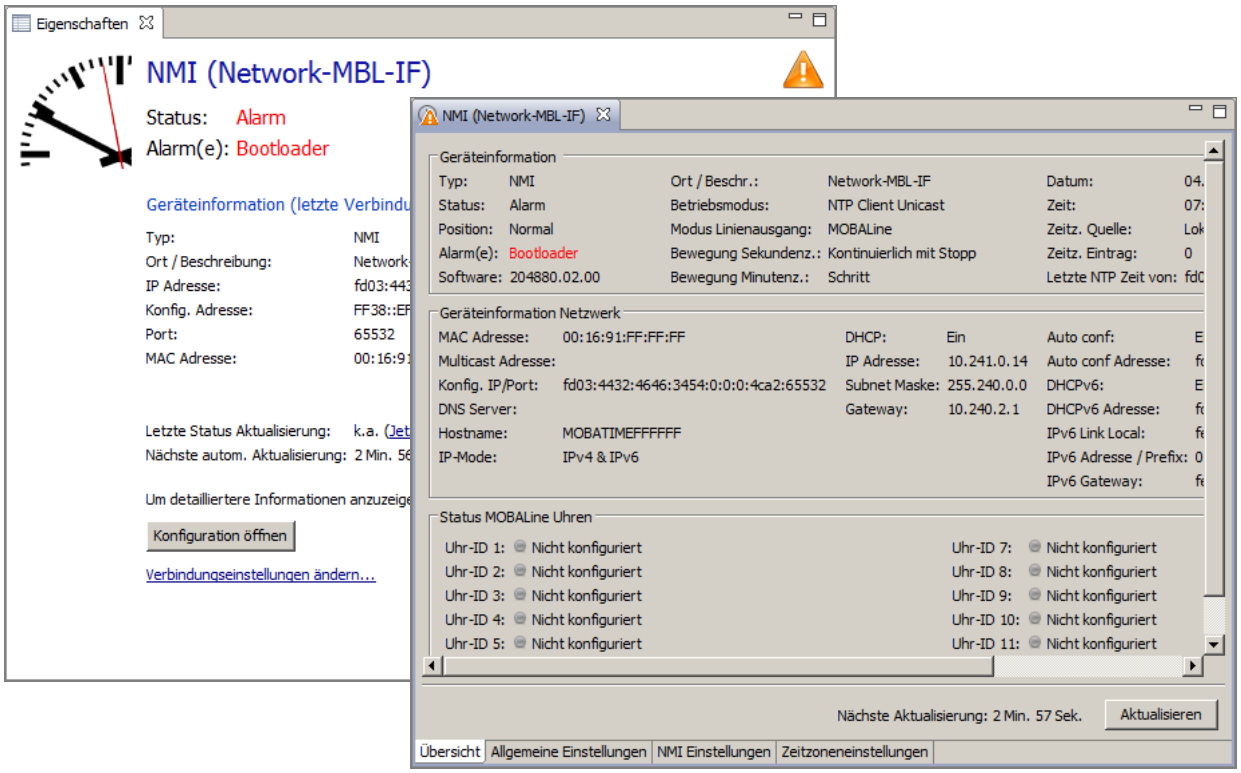
Firmware-Update

Bootloader-Update

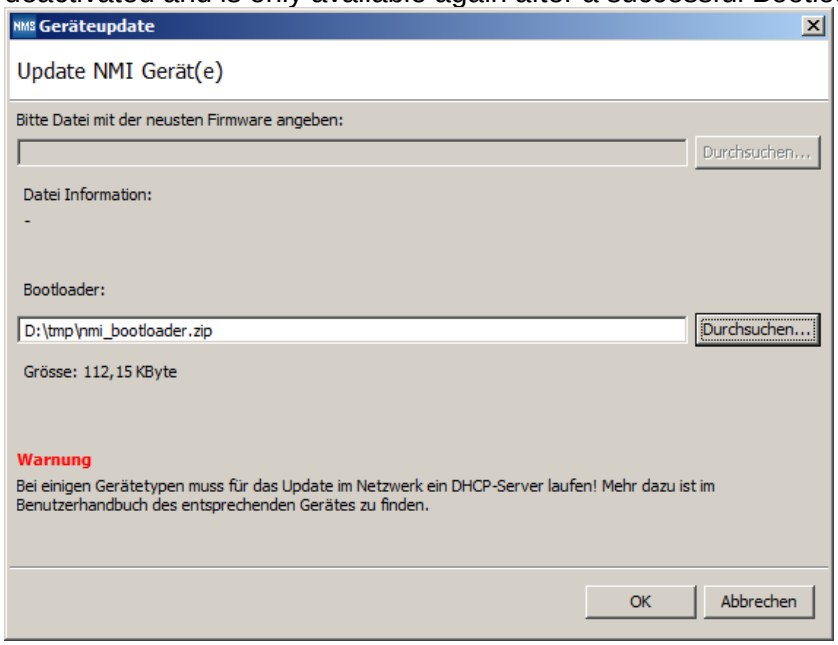
Attention: The newest version of the Firmware and Bootloader is available on *www.mobatime.com* ➔ *Customer Area* ➔ *Product Resources* under the corresponding product folder. In case the delivered device is equipped with a newer software as shown in this manual, please check the settings.

6.1 Bootloader-Update

An Update of the Bootloader is only required, when the corresponding alarm is shown in the device view:



In case of a Bootloader alarm, the input field for the Firmware (Application) is deactivated and is only available again after a successful Bootloader update:



Important: The Bootloader has to be selected as ZIP file.

6.2 Firmware Update for Network Slave Clocks and Devices via SNMPv2

6.2.1 Scope

Network Slave Clocks are now able to perform a firmware update initiated by a SNMPv2 command.
This document describes how to set up a TFTP-Server on a computer and how to send the SNMP command.

6.2.2 Procedure for the Firmware Update

1) Download the TFTP32/64 tool
2) Create a folder on the computer hard drive and copy the files "tftpd32.ini", "tftpd32.chm" and "tftpd32.exe" into it, then run "tftpd32.exe.
3) Disable all checkboxes under Settings->Global Settings to only start the TFTP Server service
4) Copy the firmware file (.bin file) into the same folder
5) Start the SNMP manager and send the set command mbnscCommandFirmwUpd with configured value (name of file, e.g. sen40.bin, make sure that the filename is not too long max. 9 characters acc. MIB)
6) For DC clocks, send the set command mbnscCommandConfigCmd with configured value to 1. This step is not necessary for analogue clocks.
7) Progress of file transfer is shown in tftpd32 window.
   When the file transfer is completed then the network slave clock does automatically reset and loads newly received firmware.
8) Close tftpd32 window
9) Perform a factory reset (load default values)

Important: The SNMP manager hast to be on the same computer as the TFTP server.

7 Parameters / Default Settings

Description:	Available	Default Value	Value Range	Type / Size [Byte]	CMD ID DHCP
Network parameters					
IP mode	general	0	0=both 1=IPv4 only 2=IPv6 only	unsig. Byte / 1	-
IPv4 address[2]	general	0.0.0.0	-	see chapter 7.3	IP-Address [50]
IPv4 Subnet mask[2]	general	0.0.0.0	-	see chapter 7.3	Subnet mask [3]
IPv4 Gateway address[2]	general	0.0.0.0	-	see chapter 7.3	Gateway [1]
DNS server address (IPv4 or IPv6)	general	empty	-	see chapter 7.3	DNS server [6] or <23>
IPv6 configuration	general	0	0=SLAAC+DHCPv6 1=SLAAC only 2=DHCPv6 only 3=both off	unsig. Byte / 1	
IPv6 address link local	general	chap. 3.1	-	see chapter 7.3	
IPv6 address autoconfig (SLAAC)	general	0::0	-	see chapter 7.3	
IPv6 address DHCPv6	general	0::0	-	see chapter 7.3	IPv6_Adr <5>
IPv6 address fix (set manually)	general	0::0	empty=not config.	see chapter 7.3	
IPv6 fix address prefix	general	64	-	unsig. Byte / 1	
IPv6 gateway address	general	0.0.0.0	-	see chapter 7.3	Subnet mask [3]
Host name	general	MOBATIMExx xxxx[6]	Text	ASCII string / 20	
SNMP agent (get and set)	general	0	0=off / 1=on	unsig. byte / 1	snmp_mode
Synchronization parameters					
NTP server address 1 (IPv4, IPv6 or name[5])	general	0.0.0.0	-	see chapter 7.3	NTP server [42] <31> or ntp1
NTP server address 2 (IPv4, IPv6 or name[5])	general	0.0.0.0	-	see chapter 7.3	NTP server [42] <31> or ntp2
NTP server address 3 (IPv4, IPv6 or name[5])	general	0.0.0.0	-	see chapter 7.3	NTP server [42] <31> or ntp3
NTP server address 4 (IPv4, IPv6 or name[5])	general	0.0.0.0	-	see chapter 7.3	NTP server [42] <31> or ntp4
NTP poll interval [s]	general	10	10...999	unsig. word / 2	ntppoll
Time zone parameters					
Index of currently used time zone	general	1	1…255 see chapter 7.4	unsig. byte / 1	tz_nbr[3]
Mode parameters					

Display brightness	DC3/ECO-DC/DA/DK2/DSC	“A”	1-30, A	ASCII string / 2 [4)]	brightness
Time display format	DC3/ECO-DC/DA/DK2/DSC	“24”	12, 24	ASCII string / 2[4]	time_format
Display alternating mode[1]	DC3/ECO-DC/DA/DK2/DSC	“1”	1…6	ASCII string / 2[4]	disp_mode
IR remote control autolock time	DC3/DA/DK2/DSC	“U”	1-60, U	ASCII string / 2[4]	ir_lock
Time display leading zeroes	DC3/DA/DK2/DSC	“1”	1, 2	ASCII string / 2[4]	time_zeroes
Date display leading zeroes	DC3/DA/DK2/DSC	“2”	1, 2	ASCII string / 2[4]	date_zeroes
Temperature units	DC3/DA/DK2/DSC	“C”	C, F	ASCII string / 2[4]	temp_units
Clock operation mode	DC3/DA/DK2/DSC	“0”	0…2	ASCII string / 2[4]	clock_mode
Average current derating	DC3/ECO-DC/DA/DK2/DSC	“0”	0…5	ASCII string / 2[4]	disp_derating
Light measurement correction	DC3/ECO-DC/DA/DK2/DSC	“0”	0…10	ASCII string / 2[4]	light_corr
Temperature sensor activation	DC3/DA/DK2/DSC	“1”	1, 3, 4	ASCII string / 2[4]	sensor_type
Temperature sensor 1 IP address	DC3/DA/DK2/DSC	0.0.0.0	-	byte array / 4	sensor1
Temperature sensor 2 IP address	DC3/DA/DK2/DSC	0.0.0.0	-	byte array / 4	sensor2
The second circle display mode	DA	1	1-5	ASCII string / 2[4]	circle_display
First language selection	DK2	“1”	1-16	ASCII string / 2[4]	lang1
Second language selection	DK2	“N”	1-16, N	ASCII string / 2[4]	lang2
Third language selection	DK2	“N”	1-16, N	ASCII string / 2[4]	lang3
Temperature units for second selected language	DK2	“C”	C, F	ASCII string / 2[4]	t2u
Temperature units for third selected language	DK2	“C”	C, F	ASCII string / 2[4]	t3u
Language switch mode for automatic language switching over in one display alternating cycle	DK2	“A”	S=single / A=all	ASCII string / 2[4]	lang_sw_m
Number of characters used for weekday names	DK2	“3”	2, 3	ASCII string / 2[4]	day_chars
Weekday and month display format	DK2	“2”	1=first capital 2=all capitals	ASCII string / 2[4]	name_form
Display of description for first measured temperature	DK2	“N”	Y / N	ASCII string / 2[4]	t1d_en
Description text for first measured temperature	DK2	-	-	ASCII string / 5	t1desc
Display of description for second measured temperature	DK2	“N”	Y / N	ASCII string / 2[4]	t2d_en
Description text for second measured temperature	DK2	-	-	ASCII string / 5	t2desc
Index of time zone for world time 1	DK2	“N”	1…255 (255=None) see chapter 7.4	unsig. byte / 1	wt1
Description text for World time 1	DK2	-	-	ASCII string / 8	wt1desc
Index of time zone for world time 2	DK2	“N”	1…255 (255=None) see chapter 7.4	unsig. byte / 1	wt2
Description text for World time 2	DK2	-	-	ASCII string / 8	wt2desc

Index of time zone for world time 3	DK2	“N”	1…255 (255=None) see chapter 7.4	unsig. byte / 1	wt3
Description text for World time 3	DK2	-	-	ASCII string / 8	wt3desc
Index of time zone for world time 4	DK2	“N”	1…255 (255=None) see chapter 7.4	unsig. byte / 1	wt4
Description text for World time 4	DK2	-	-	ASCII string / 8	wt4desc
Index of time zone for world time 5	DK2	“N”	1…255 (255=None) see chapter 7.4	unsig. byte / 1	wt5
Description text for World time 5	DK2	-	-	ASCII string / 8	wt5desc
World time switch mode for automatic time zone switching over in one display alternating cycle	DK2	“A”	S=single / A=all	ASCII string / 2[4]	wt_sw_m
Time code mode of the slave clock line	NMI	0 = off	0 = off 1 = MOBALine 2 = DCF-Active	unsig. byte / 1	clock_line_mode
Mode of MOBALine side clock line	NMI	0 = run	0 = run 1 = 12:00 2 = ClockID	unsig. byte / 1	mbl_line_mode
Mode of minute hand on MOBALine	NMI	0 = minute step	0 = minute step 1 = half minute step 2 = continuous	unsig. byte / 1	mbl_minhand_ mode
Mode of DCF-Active side clock line	NMI	1 = mode 1	1…6	unsig. byte / 1	dcf_active_mode
Mode of DCF-CurrentLoop out	NMI	0 = off	0 = off 1 = on	unsig. byte / 1	dcf_cl_mode
Supervision parameters					
SNMP manager address (IPv4 or IPv6)	general	empty	0.0.0.0 / 0::0 = off	see chapter 7.3	snmp1
SNMP manager address (IPv4 or IPv6)	general	empty	0.0.0.0 / 0::0 = off	see chapter 7.3	snmp2
SNMP alive notification interval [min]	general	30	1...1440 / 0=off	unsig. word / 2	alive_to

1) Parameters are not identical in all types
2) All these must be set together.
3) Must be configured by the DIP switch in NBU 190 and SEN / SAN 40.
4) Values like “02”, “<space>2”, “2<0x00>”, “<space>A” and “A<0x00>” (case insensitive) allowed
5) If the NTP server is configured via DNS name, a DNS Server must also be set on the device and be available in the network.
6) Where the last 6 digits correspond to the last 6 digits of the MAC address, e.g. MAC 00:16:91:12:34:56 → MOBATIME123456

7.1 Alarms

The alarms depend on the type of device and are not available on all devices.

No.	Error message	Description / action
0	Synchronization	No time information for more than 1 hour. Check settings Check NTP server.
1	Supply	Supply failure (only in redundant supplies)
2	Slave	A cascaded clock has an error or no connection. According to the error, check the connection and/or cascaded clock.
3	Illumination	Error in the clock illumination
4	Second hand error	The position of the second hand is wrong. Check the assembly hand.
5	Minute hand error	The position of the minute hand is wrong. Check the assembly hand.
6	Restart	Restart clock (e.g. configuration changes)
7	Communication error	Error in the communication
8	Time zone error	Time zone non-existent Check settings, check time zone server.
9	Authentication	Password is wrong. Check password in MOBA-NMS.
10	Bootloader	Bootloader is outdated ➔ Support

Bits 11-31 are not used. Bits 32-63 are reserved for device-specific alarms.

Specific alarms for DC clocks (DC3, ECO-DC):

No.	Error message	Description / action
32	NVMemWrite	indicates that there was an error during writing to the Data Flash (e.g. after configuration change or during update)

Specific alarms for NMI:

No.	Error message	Description / action
32	SideClockStateError	indicates that that one at least one supervised sideclock has an error.
33	LineCurrentError	Indicates an overcurrent on the line driver.

7.2 Status

The status bits depend on the device and are not available on all devices.

No.	Status	Description
0	Time OK	1 = Time is set
1	12 o'clock position	1 = 12:00 position

7.3 IP definition

IP parameters support the following syntax:

Length in command	Meaning	Type
4	IPv4	Byte array
16	IPv6	Byte array
5-30	Domain name / host name *	ASCII string

* only NTP allows DNS name

For historical reasons, the hostname must be at least 5 characters long.

A special case occurs when an IPv6 address is also a valid hostname, in which case the message is misinterpreted as a hostname. However, the chance that a random IPv6 address is also a valid hostname is extremely small ($<1:10^9$).

7.4 Time zone source selection

0 … 64	internal TZ
65 … 128	user configurable
129 ... 143	TZ server
144 ... 255	device specific

8 Time zone table

Time zone entries in the standard time zone table (version 10.2).

No.	City / State	UTC Offset	DST	Standard → DST	DST → Standard
00	UTC (GMT), Monrovia	0	No		
01	London, Dublin, Lisbon	0	Yes	Last Sun. Mar. (01:00)	Last Sun. Oct. (02:00)
02	Brussels, Amsterdam, Berlin, Bern, Copenhagen, Madrid, Oslo, Paris, Rome, Stockholm, Vienna, Belgrade, Bratislava, Budapest, Ljubljana, Prague, Sarajevo, Warsaw, Zagreb	+1	Yes	Last Sun. Mar. (02:00)	Last Sun. Oct. (03:00)
03	Athens, Helsinki, Riga, Tallinn, Sofia, Vilnius	+2	Yes	Last Sun. Mar. (03:00)	Last Sun. Oct. (04:00)
04	Bucharest	+2	Yes	Last Sun. Mar. (03:00)	Last Sun. Oct. (04:00)
05	Pretoria, Harare, Kaliningrad	+2	No		
06	Amman	+2	Yes	Last Thu. Mar. (23:59)	Last Fri. Oct. (01:00)
07	UTC (GMT)	0	No		
08	Istanbul, Kuwait City, Minsk, Moscow, Saint Petersburg, Volgograd	+3	No		
09	Praia, Cape Verde	-1	No		
10	UTC (GMT)	0	No		
11	Abu Dhabi, Muscat, Tbilisi, Samara	+4	No		
12	Kabul	+4.5	No		
13	Adamstown (Pitcairn Is.)	-8	No		
14	Tashkent, Islamabad, Karachi, Yekaterinburg	+5	No		
15	Mumbai, Kolkata, Chennai, New Delhi, Colombo	+5.5	No		
16	Astana, Thimphu, Dhaka, Novosibirsk	+6	No		
17	Bangkok, Hanoi, Jakarta, Krasnoyarsk	+7	No		
18	Beijing, Hong Kong, Singapore, Taipei, Irkutsk	+8	No		
19	Tokyo, Seoul, Yakutsk	+9	No		
20	Gambier Island	-9	No		
21	South Australia: Adelaide	+9.5	Yes	1st Sun. Oct (02:00)	1st Sun. Apr. (03:00)
22	Northern Territory: Darwin	+9.5	No		
23	Brisbane, Guam, Port Moresby, Vladivostok	+10	No		
24	Sydney, Canberra, Melbourne, Tasmania: Hobart	+10	Yes	1st Sun. Oct. (02.00)	1st Sun. Apr. (03:00)
25	UTC (GMT)	0	No		
26	UTC (GMT)	0	No		
27	Honiara (Solomon Is.), Magadan, Noumea (New Caledonia)	+11	No		
28	Auckland, Wellington	+12	Yes	Last Sun. Sep. (02:00)	1st Sun. Apr. (03:00)
29	Majuro (Marshall Is.), Anadyr	+12	No		
30	Azores	-1	Yes	Last Sun. Mar. (00:00)	Last Sun. Oct. (01:00)
31	Middle Atlantic	-2	No		
32	Brasilia	-3	Yes	3rd Sun. Oct. (00:00)	3rd Sun. Feb. (00:00)
33	Buenos Aires	-3	No		
34	Newfoundland	-3.5	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)
35	Atlantic Time (Canada)	-4	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)
36	La Paz	-4	No		
37	Bogota, Lima, Quito	-5	No		
38	New York, Eastern Time (US & Canada)	-5	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)

39	Chicago, Central Time (US & Canada)	-6	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)
40	Tegucigalpa, Honduras	-6	No		
41	Phoenix, Arizona	-7	No		
42	Denver, Mountain Time	-7	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)
43	Los Angeles, Pacific Time	-8	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)
44	Anchorage, Alaska (US)	-9	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)
45	Honolulu, Hawaii (US)	-10	No		
46	Midway Islands (US)	-11	No		
47	Mexico City, Mexico	-6	Yes	1st Sun. Apr. (02:00)	Last Sun. Oct. (02:00)
48	Adak (Aleutian Is.)	-10	Yes	2nd Sun. Mar. (02:00)	1st Sun. Nov. (02:00)
49	UTC (GMT)	0	No		
50	UTC (GMT)	0	No		
51	UTC (GMT)	0	No		
52	UTC (GMT)	0	No		
53	UTC (GMT)	0	No		
54	Ittoqqortoormiit, Greenland	-1	Yes	Last Sun. Mar. (00:00)	Last Sun. Oct. (01:00)
55	Nuuk, Qaanaaq,Greenland	-3	Yes	Last Sat. Mar. (22:00)	Last Sat. Oct. (23:00)
56	Not used				
57	Western Australia: Perth	+8	No		
58	Caracas	-4.5	No		
59	CET standard time	+1	No		
60	Not used				
61	Not used				
62	Baku	+4	Yes	Last Sun. Mar. (04:00)	Last Sun. Oct. (05:00)
63	UTC (GMT)	0	No		
64	UTC (GMT)	0	No		

In countries where the DST switch date changes annually (e.g. Iran, Israel), the time zone has to be defined manually in the user time zone table (entries 80 – 99).

Legend:

UTC:	Universal Time Coordinate, equivalent to GMT
DST:	Daylight Saving Time
DST Change:	Daylight Saving Time changeover
Standard → DST:	Time change from Standard time (Winter time) to Summer time
DST → Standard:	Time change from Summer time to Standard time (Winter time)

Example:

2nd last Sun. Mar. (02:00)	Switch over on the penultimate Sunday in March at 02.00 hours local time.

Important: The Time Zone Table is usually updated as needed. The current table is available for download under the following address: *www.mobatime.com* ➔ *Customer Area* ➔ *Customer Support* ➔ *Support Resources* ➔ *Time Zone Table*. In case your device is equipped with a newer version than shown in this manual, the current time zone settings should be checked.

Modifications / updating the time zone table:

In the DTS device the time zone tables are stored in the files */etc/mbsn.tbl* (standard table) and */etc/usersn.tbl* (user table).
The user table can be changed with Moser-Baer AG software such as ETCW or MOBA-NMS.
Using MOBA-NMS, it can be downloaded from there, otherwise, it must be copied on to the DTS 4138 in accordance with the update instructions (chapter "**Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**").

Notice: The file names ***mbsn.tbl*** and ***usersn.tbl*** must be written in small letters.

9 Technical specifications

Synchronization	Network Time Protocol (NTP), UTC, RFC 1305, RFC 5905 and RFC 4330 Up to four NTP servers can be configured.
Monitoring	The clock's status is requested with the PC software MOBA-NMS SNMPv2c alarm and alive notifications and/or SNMP GET for integration in a network management system
Calculation of local time and seasonal time changes	Automatic seasonal time changes can be selected from 7 - 64 predefined rules or seasonal time changes from external MOBATIME time zone server from 15 rules
Accuracy	Deviation typically <+/-50 ms in synchronized state
Loss of synchronization	Alarm message (notification) after 1 h Hand position on the 12:00 position or blinking of ":" after 24 h Typical deviation after 24 h: <+/-2 s
Network	Ethernet 10/100Mbit UDP IPv4 and IPv6 IPv4: static IP, DHCP IPv6: static IP, DHCPv6, SLAAC
Power supply	PoE or in part 230 VAC as an alternative or 24 VDC PoE according to the defined classes
Standards	CE

Network services:

NTP / SNTP	UDP, port 123	time received / requested
TFTP	UDP, port 69	update
SNMP	UDP, port 161	operation / monitoring version V2c
	UDP, port 162	alarm notification, see SNMP
DHCP	UDP, port 68	dyn. address assignment (Client)
DHCPv6	UDP, port 546	(client), port 547 (server) dyn. address assignment IPv6 w/o authent. and without reconfiguration
DNS	UDP, port 53	address resolution (Client)
ECHO	ICMP	"Ping"

Communication via Multicast:
-RFC 2236: Internet group management protocol, version 2
-RFC 1112: Host extensions for IP multicasting
-RFC 4601: Protocol independent multicast - sparse mode (PIM-SM)
-RFC 3973: Protocol independent multicast - dense mode (PIM-DM)

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